Quick Summary:

$$\text{Work} = \lim_{n\to\infty}\sum_{i=1}^{n}(FORCE)(DIST)$$
$$= \int_a^b (FORCE)(DIST)$$

Problem type 1: (Leaky bucket/spring)

FORCE = $f(x_i)$, DISTANCE = Δx,

Problem type 2: (Chain/pumping)

FORCE = weight of each horizontal slice

DISTANCE = distance moved by a slice

For a chain, we have

k = density = force per distance

FORCE = weight of slice = $k\Delta x$

DISTANCE = distance moved by slice

For pumping, we have

k = weight per volume

FORCE = k(area of horiz. slice)Δy

DISTANCE = distance moved by slice

Some unit facts:

	Metric	**Standard**
Mass	kg	
Accel.	9.8 m/s^2	32 ft/s^2
Force	Newtons N = $kg \cdot m/s^2$	pounds = lbs
Dist.	m = meters	ft = feet
Work	Joules J = N·m	foot-pounds ft·lbs

g = grams, in = inches, yd = yards, mi = miles

1000 g = 1 kg

100 cm = 1 meter

12 inches = 1 foot

3 feet = 1 yard

5280 ft = 1 mile

Density of water = 1000 kg/m^3 = 9800 N/m^3
= 62.5 lbs/ft^3

Review: Particular scenarios

Type 1 Problems:

FORCE = $f(x_i)$, DISTANCE = Δx

1. HW 4A/1, 2, 8, 9 and HW 4C/1
   Given force, just need to integrate!

$$\text{Work} = \int_a^b f(x)\,dx$$

2. HW 4A/3, 4 (Springs)
   (i) Covert all to meters
   (ii) Label natural length, L, and note that L corresponds to x = 0.
   Force = f(x) = kx

$$\text{Work} = \int_a^b kx\,dx$$

   Step 1: Find k
   Step 2: Answer question.

Type 2 Problems:

FORCE = weight of a horizontal slice,
DISTANCE = distance to top

3. HW 4A/5 and HW 4C/2 (Chain)
   (i) k = density of chain = weight/dist
   (ii) FORCE at a subdivision = $k\Delta x$
   (iii) Label top x=0, then DIST = x_i.

$$\text{Work} = \int_a^b x\,k dx$$

4. HW 4A/6,7 and HW 4C/3 (Pumping)

Water density = 9800 N/m^3 = 62.5 lbs/ft^3

   (i) Label (put in xy-plane)
   (ii) Draw a horizontal slice and find a formula for its area.
   (iii) FORCE = (Density)(Area)Δy
   (iv) DIST = distance to top

$$\text{Work} = \int_a^b (\text{Dist})(\text{Density})(\text{Area})\,\text{dy}$$